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# UHT Processing

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## Introduction

While pasteurization conditions effectively eliminate potential pathogenic microorganisms, it is not sufficient to inactivate the thermoresistant spores in milk. The term **sterilization** refers to the complete elimination of all microorganisms. The food industry uses the more realistic term "**commercial sterilization**"; a product is not necessarily free of all microorganisms, but those that survive the sterilization process are unlikely to grow during storage and cause product spoilage.

In canning we need to ensure the "cold spot" has reached the desired temperature for the desired time. With most canned products, there is a low rate of heat penetration to the thermal centre. This leads to overprocessing of some portions, and damage to nutritional and sensory characteristics, especially near the walls of the container. This implies long processing times at lower temperatures.

Milk can be made commercially sterile by subjecting it to temperatures in excess of 100° C, and packaging it in air-tight containers. The milk may be packaged either before or after sterilization. The basis of **UHT**, or ultra-high temperature, is the sterilization of food **before** packaging, then filling into pre-sterilized containers in a sterile atmosphere. Milk that is processed in this way using temperatures exceeding 135° C, permits a decrease in the necessary holding time (to 2-5 s) enabling a **continuous flow** operation.

Some examples of food products processed with UHT are:

- liquid products - milk, juices, cream, yoghurt, wine, salad dressings
- foods with discrete particles - baby foods; tomato products; fruits and vegetables juices; soups
- larger particles - stews



## Advantages of UHT

**High quality:**

The D and Z values are higher for quality factors than microorganisms. The reduction in process time due to higher temperature (UHTST) and the minimal come-up and cool-down time leads to a higher quality product.

**Long shelf life:**

Greater than 6 months, without refrigeration, can be expected.

**Packaging size:**

Processing conditions are independent of container size, thus allowing for the filling of large containers for food-service or sale to food manufacturers (aseptic fruit purees in stainless steel totes).

**Cheaper packaging:**

Both cost of package and storage and transportation costs; laminated packaging allows for use of extensive graphics

**Difficulties with UHT****Sterility:**

Complexity of equipment and plant are needed to maintain sterile atmosphere between processing and packaging (packaging materials, pipework, tanks, pumps); higher skilled operators; sterility must be maintained through aseptic packaging

**Particle Size:**

With larger particulates there is a danger of overcooking of surfaces and need to transport material - both limits particle size

**Equipment:**

There is a lack of equipment for particulate sterilization, due especially to settling of solids and thus overprocessing

**Keeping Quality:**

Heat stable lipases or proteases can lead to flavour deterioration, age gelation of the milk over time - nothing lasts forever! There is also a more pronounced cooked flavour to UHT milk.

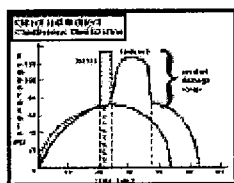
**UHT Methods**

There are two principal methods of UHT treatment:

1. Direct Heating
2. Indirect Heating

**Direct heating systems**

The product is heated by direct contact with steam of potable or culinary quality. The main advantage of direct heating is that the product is held at the elevated temperature for a shorter period of time. For a heat-sensitive product such as milk, this means less damage.



Indirect vs Direct Heating (17 KB)

There are two methods of direct heating (please see schematic diagrams of the equipment;

1. injection
2. infusion

**Injection:** High pressure steam is injected into pre-heated liquid by a steam injector leading to a rapid rise in temperature. After holding, the product is flash-cooled in a vacuum to remove water equivalent to amount of condensed steam used. This method allows fast heating and cooling, and volatile removal, but is only suitable for some products. It is energy intensive and because the product comes in contact with hot equipment, there is potential for flavour damage.

**Infusion:** The liquid product stream is pumped through a distributing nozzle into a chamber of high pressure steam. This system is characterized by a large steam volume and a small product volume, distributed in a large surface area of product. Product temperature is accurately controlled via pressure. Additional holding time may be accomplished through the use of plate or tubular heat exchangers, followed by flash cooling in vacuum chamber. This method has several advantages:

- instantaneous heating and rapid cooling
- no localized overheating or burn-on
- suitable for low and higher viscosity products

## Indirect heating systems

The heating medium and product are not in direct contact, but separated by equipment contact surfaces. Several types of heat exchangers are applicable:

- plate
- tubular
- scraped surface

**Plate Heat Exchangers:** Similar to that used in HTST but operating pressures are limited by gaskets. Liquid velocities are low which could lead to uneven heating and burn-on. This method is economical in floor space, easily inspected, and allows for potential regeneration.

**Tubular Heat Exchangers:** There are several types:

- shell and tube
- shell and coil
- double tube
- triple tube

All of these tubular heat exchangers have fewer seals involved than with plates. This allows for higher pressures, thus higher flow rates and higher temperatures. The heating is more uniform but difficult to

inspect.

**Scraped Surface Heat Exchangers:** The product flows through a jacketed tube, which contains the heating medium, and is scraped from the sides with a rotating knife. This method is suitable for viscous products and particulates (< 1 cm) such as fruit sauces, and can be adjusted for different products by changing configuration of rotor. There is a problem with larger particulates; the long process time for particulates would mean long holding sections which are impractical. This may lead to damaged solids and overprocessing of sauce.



## Packaging for Aseptic Processing

The most important point to remember is that it must be **sterile**! All handling of product post-process must be within the sterile environment.

There are 5 basic types of aseptic packaging lines:

1. **Fill and seal:** preformed containers made of thermoformed plastic, glass or metal are sterilized, filled in aseptic environment, and sealed
2. **Form, fill and seal:** roll of material is sterilized, formed in sterile environment, filled, sealed e.g. tetrapak
3. **Erect, fill and seal:** using knocked-down blanks, erected, sterilized, filled, sealed. e.g. gable-top cartons, cambri-bloc
4. **Thermoform, fill, sealed** roll stock sterilized, thermoformed, filled, sealed aseptically. e.g. creamers, plastic soup cans
5. **Blow mold, fill, seal:**

There are several different **package forms** that are used in aseptic UHT processing:

- cans
- paperboard/plastic/foil/plastic laminates
- flexible pouches
- thermoformed plastic containers
- flow molded containers
- bag-in-box
- bulk totes

It is also worth mentioning that many products that are UHT heat treated are not aseptically packaged. This gives them the advantage of a longer shelf life at refrigeration temperatures compared to pasteurization, but it does not produce a shelf-stable product at ambient temperatures, due to the possibility of recontamination post-processing.



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